Remarks/Arguments

Reconsideration of the above-identified application in view of the present amendment is respectfully requested.

By the present amendment, the paragraph beginning on page 19, line 20 has been amended to change the term "electrically heated" coil to "electrical" coil. This amendment to the specification attempts to clarify the specification so at to avoid any potential ambiguity in construing the claims. This amendment to the specification also adds no new matter as it merely eliminates one word to clarify operation of the induction heating.

Claim 1 has been amended to recite that the low-carbon steel tube is an "induction heated" low-carbon steel tube. Claims 5 and 7 have been amended to recite that the low-carbon steel tube is "induction heated". Support for these limitations can be found in the specification on page 19.

Additionally, a Declaration under 37 CFR §1.132 has been provided with this amendment. The Declaration includes comparative examples that show induction heated low-carbon steel tubes of independent claims 1 and 5 possess properties not possessed by conventionally heated low-carbon steel tubes.

Below is a discussion of the 35 U.S.C. §112 rejection of claims 1 and 5, the 35 U.S.C. §103 rejection of claims 1, 3 and 5 in view of Japanese Patent 410140283 (hereinafter, "JP '283"), the 35 U.S.C. §103 rejection of claim 7 in view of JP '283 and ASM Handbook Volume 4, Heat Treating (hereinafter, "ASM Handbook"), the 35 U.S.C. §103 rejection of claims 1 and 3 in view of Japanese Patent 406184635 (hereinafter, "JP '635"), and the nonstatutory obviousness-type double patenting rejection over U.S. Patent No. 6,386,583 in view of JP '283 and ASM Handbook.

35 U.S.C. §112 rejection of claims 1 and 5

Claims 1 and 5 were rejected as failing comply with the written description requirement. The Office Action argues that the amendment of the fracture temperature from -40°C to -100°C does not appear to be supported by the original disclosure.

The specification provides support for the -100°C limitation. Page 21, lines 5-12 of the specification state that:

> "Surprisingly, it was found that the seamless steel of low-carbon steel heat treated by this process [i.e., the induction heat treatment process] remains ductile at temperatures down to about -100°C. It is believed that the induction furnace heats the seamless tube of low-carbon steel at a quicker rate and more

> uniformly than a conventional fuel furnace, and that this quicker and more uniform heating provides the seamless tube of low-carbon steel with its improved ductility down to -100°C."

Accordingly, withdrawal of the 35 U.S.C. §112 rejection of claims 1 and 5 is respectfully requested.

35 U.S.C. §103 rejection of claims 1, 3, and 5 in view of JP '283

Claims 1, 3 and 5 were rejected under 35 U.S.C. §103(a) as being unpatentable over the translation of JP '283.

Claim 1 is patentable over JP '283 because: (1) JP '283 does not teach or suggest an induction heated low-carbon steel tube, (2) JP '283 does not teach or suggest a low-carbon steel tube that yields plastically more than about 5% before fracturing at temperatures down to about -100°C when stress sufficient to cause the low-carbon steel tube to so yield is applied to the low-carbon steel tube, and (3) the induction heated low-carbon steel tube of claim 1 exhibits unexpected result.

As noted in the August 29, 2005 Office Action, claim 6 of JP '283 discloses a steel tube having a composition with constituents whose weight percent ranges overlap those recited by claim 1.

JP '283, however, does not teach or suggest that the steel tube is induction heated during its manufacturing process. The only reference to heat treating in JP '283 is at paragraph 36 of the translation. Paragraph 36 indicates that during formation the tube can be annealed, normalized, and tempered at various temperatures. There is nothing in JP '283 that teaches or suggests that the annealing, normalizing, or tempering is performed by induction heating.

JP '283 also does not disclose or suggest a low-carbon steel tube that yields plastically more than about 5% before fracturing at temperatures down to about -100°C.

It well known to one skilled in the art that the mechanical properties of a low-carbon steel tube (and for that matter any article formed from steel) are a function of not just the composition of the low-carbon steel, but also of the processes used to form the low-carbon steel into the low-carbon steel tube. Thus, although the composition of the low-carbon steel used to form the low-carbon steel tube of the present application could potentially be prima facie obvious over a similar low-carbon steel composition, the mechanical properties of a low carbon-steel tube formed from the low-carbon steel would not.

This point is exemplified in the present application. The present application teaches two different processes for heat treating low-carbon steel tubes having similar low-carbon steel compositions. In one heat treatment process, as discussed on page 29 of the application, the low-carbon steel tube is heat treated to a temperature of about 900°C in a conventional reheating oven and then tempered to about 500°C to form a low-carbon steel tube that yields plastically at temperature down to about -40°C. In an alternate heat treatment process as discussed on page 30 of the present application, a similar low-carbon steel tube is heat treated by induction heating the low-carbon steel tube to 900°C. The induction heated low-carbon steel tube has substantially improved low-temperature properties, i.e., yields plastically at temperatures down to -100°C, even though no tempering process in performed subsequent to the induction heating process. Thus, different heat treatment processing of the low-carbon steel tubes with similar compositions yields low-carbon steel tubes with different mechanical properties.

JP '283 does not teach or suggest induction heating the low-carbon steel tube only heating the low-carbon steel tube in a conventional oven and tempering the low-carbon steel tube. Thus, JP '283 does not teach or suggest a method or treatment process for forming a low-carbon steel member that yields plastically at temperatures down to about -100°C and, therefore, do not teach a low-carbon steel that yield plastically at least about 5% at temperatures down to about -100°C.

Additionally, the attached Declaration under 37 CFR 1.132, from Mr. Erike, a senior technical specialist with over 20 years experience in materials engineering and metallurgy, indicates that an induction heated low-carbon steel tube having a composition as claimed exhibits unexpected properties compared to a convention heat-treated low-carbon steel tube having a similar composition.

Specifically, Mr. Erike states that:

> It is common knowledge that steels exhibit a ductile-to-brittle fracture transition at low temperatures. The ductile-to-brittle fracture transition is a marked change in fracture resistance of steel with changes in one or more test variables. It occurs only in certain steels within ranges that depend on the steel. Temperature, stress state, and strain rate are among the variables that can give rise to fracture transition.
>
> Experiments were performed comparing the maximum temperature of brittle area outbreak and tensile strength for examples (Ex. 1-3) of low-carbon steels having similar compositions but processed into seamless tubes using

different processes. The results are plotted in the attached graph. For each of the examples 1-3, the low-carbon steel used to form the seamless tubes consisted essentially of, by weight, about 0.07% to about 0.12% carbon, about 0.7% to about 1.60% manganese, up to about 0.020% phosphorous, up to about 0.015% sulfur, about 0.06% to about 0.35% silicon, about 0.25% to about 1.20% chromium, up to about 0.65% nickel, about 0.20% to about 0.70% molybdenum, up to about 0.35% copper, about 0.02% to about 0.06% aluminum, up to about 0.05% vanadium, up to about 0.25% residual elements, and the balance iron. The maximum temperature of brittle area outbreak was determined using a Charpy V-impact test on steel samples obtained from seamless low carbon steel tubes formed by the different processes. The tensile strength of steel samples obtained from seamless low carbon steel tubes formed by the different processes was measured in accordance with ASTM E8/E8M. In each of examples 1-3, the low carbon steel was cast, hot rolled to form a cylindrical billet, and then pierced to form a tube. The low carbon steel tube of example 1 was then quench tempered to a temperature of about 620°C and then cold drawn to form a seamless tube. The low carbon steel tube of example 2, after piercing, was cold drawn and quench tempered to a temperature of about 520°C. The low carbon steel tube of example 3, after piercing, was cold drawn and then induction heated to a temperature of about 520°C.

The low-carbon steel of example 1 had a tensile strength of about 925 N/mm^2 and maximum temperature of brittle area outbreak of about -20°C. The low-carbon steel of example 1 had a tensile strength of about 912 N/mm^2 and maximum temperature of brittle area outbreak of about -80°C. The low-carbon steel of example 1 had a tensile strength of about 925 N/mm^2 and maximum temperature of brittle area outbreak of about -105°C.

The low carbon steel of example 3, which was heat treated by induction heating, exhibited a remarkable improvement in maximum temperature of brittle area outbreak compared to the low carbon steel of examples 1 and 2 remaining ductile and plastic at temperatures below -100°C.

Based on my experience in low carbon steel engineering and seamless tube fabrication as well as my review of low-carbon steel and seamless tube fabrication literature, a low-carbon steel having plasticity down to about -100°C has not been previously formed. Additionally, based on my experience in low carbon steel engineering and seamless tube fabrication, it would not be reasonable to expect that an low carbon steel heat treated by an induction heating process would out perform the same material produced with gas or electric furnace heat treatment process.

Thus, it is unexpected that an induction heated low-carbon steel tube having a composition as recited in claim 1 would exhibit substantially improved ductility properties at temperatures down to -100°C compared to a low-carbon steel tube having a similar

composition but heat treated by conventional heat treatment process. Therefore, withdrawal of the rejection of claim 1 is respectfully requested because JP '283 fails to teach or suggest all of the limitation of claim 1 and low-carbon steel tube recited in claim 1 exhibits unexpected results.

Claim 3 depends directly from claim 1 and recites that the low-carbon steel tube has a tensile strength of at least about 130,000 psi, a yield strength of at least about 104,000 psi, and an elongation at break of at least about 14%.

Claim 3 is patentable over JP '283 because of the aforementioned deficiencies discussed above with respect to the rejection of claim 1. Additionally, claim 3 is patentable over JP '283 because JP '283 does not teach or suggest a low-carbon steel tube that has a has a tensile strength of at least about 130,000 psi, a yield strength of at least about 104,000 psi, and an elongation at break of at least about 14%.

JP '283 does not teach or suggest the yield strength and the elongation at break of the low-carbon steel tube recited in JP '283. The tensile strength of the low-carbon steel tube of JP '283 is disclosed in Tables 3 and 4, but these tensile strength are well below the at least about 130,000 psi (896 N/mm^2) recited in claim 3. Additionally, the Office Action's argument that like compositions have like properties fails to appreciate well known metallurgical principles that the mechanical properties of a steel object are not just a function of the composition of the steel but the method or process used to form the steel object. JP '283 does not teach the specific composition of the low-carbon steel tube recited in claim 1 and do not teach the mechanical process recited in the claim (i.e., induction heating) used to form a low-carbon steel tube having the properties recited in claim 3. Thus, JP '283 fails to teach or suggest all of the limitations of claim 3 and withdrawal of the rejection of claim 3 is respectfully requested.

Claim 5 recites a method that comprises casting a billet of low-carbon steel. The billet of low-carbon steel has a first diameter and consists essentially of, by weight, about 0.07% to about 0.12% carbon, about 0.70% to about 1.60% manganese, up to about 0.020% phosphorous, up to about 0.015% sulfur, about 0.06% to about 0.35% silicon, about 0.25% to about 1.20% chromium, up to about 0.65% nickel, about 0.20% to about 0.70% molybdenum, up to about 0.35% copper, about 0.02% to about 0.06% aluminum, up to about 0.05% vanadium, up to about 0.25% residual elements, and the balance iron. The diameter of the billet of low-carbon steel is reduced by hot-rolling the billet. A tube is formed having an annular wall by piercing the billet. The thickness of the annular wall is reduced to a first

thickness by cold drawing the tube. The tube is induction heated after cold drawing to form a low-carbon steel tube that yields plastically more than about 5% before fracturing at temperatures down to about -100°C when stress sufficient to cause the low carbon steel tube to so yield is applied to the low-carbon steel tube.

Claim 5 is patentable over JP '283 because (1) JP '283 does not teach or suggest induction heating the cold drawn low-carbon steel tube so that the low-carbon steel tube yields plastically more than about 5% before fracturing at temperatures down to about -100°C when stress sufficient to cause the low-carbon steel tube to so yield is applied to the low-carbon steel tube; and (2) a low-carbon steel tube formed by the method of claim 5 exhibits unexpected results.

JP '283, as noted in the Office Action, discloses processing a seamless steel tube by forming a steel billet with a joint-less manufacturing tube method, by punching the billet, hot rolling, cold working, and then either annealing, normalizing, or hardening and tempering. JP '283 does not teach or suggest induction heating the low-carbon steel tube following cold-drawing the tube so that the tube yields plastically more than about 5% before fracturing at temperatures down to -100°C. JP '283 instead teaches heating the tube to 900°C without mention of the specific heating process to form a low-carbon steel tube. JP '283 does not teach induction heating the low-carbon steel tube and does not teach that the low carbon steel tube yields plastically more than about 5% before fracturing at temperatures down to -100°C.

Additionally, as discussed above with respect to claim 1, it is unexpected that an induction heated low-carbon steel tube having a composition as recited in claim 1 would exhibit substantially improved ductility properties at temperatures down to -100°C compared to a low-carbon steel tube having a similar composition but heat treated by conventional heat treatment process. Therefore, withdrawal of the rejection of claim 5 is respectfully requested because JP '283 fails to teach or suggest all of the limitation of claim 5 and the method recited in claim 5 exhibits unexpected results.

<u>35 U.S.C. §103 rejection of claim 7 in view of JP '283</u>

Claim 7 was rejected under 35 U.S.C. §103(a) as being unpatentable over the translation of JP '283 and ASM Handbook.

Claim 7 is patentable over JP '283 and ASM Handbook because (1) JP '283 in view of ASM Handbook do not teach or suggest induction heating a low-carbon steel tube to form a low-carbon steel tube that yields plastically more than about 5% before fracturing at

temperatures down to about -100°C when stress sufficient to cause the low-carbon steel tube to so yield is applied to the low-carbon steel tube; and (2) a low-carbon steel tube formed by the method of claim 7 exhibits unexpected results.

JP '283, as noted in the Office Action, discloses processing a seamless steel tube by forming a steel billet with a joint-less manufacturing tube method, by punching the billet, hot rolling, cold working, and either by annealing to 580°C, normalizing to 900°C, or hardening to 900°C and tempering at 580°C.

JP '283 does not teach or suggest induction heating the low-carbon steel tube following cold-drawing or induction heating the tube to form a tube that yields plastically more than about 5% before fracturing at temperatures down to -100°C. To overcome this deficiency in the reference, the Office Action states that ASM Handbook teaches that induction heating can provide energy savings and higher heating rates than furnace heat treating methods, provides ease of automation and control, reduced work space, quiet clean working conditions... and that it would be obvious to use induction heating as taught in ASM Handbook for the heat treatment process in JP '283 to benefit from the advantages taught in ASM Handbook.

The applicant fails to see the relevance of this argument to the overcome the deficiencies in JP '283. It is well settled that to establish *prima facie* obviousness of a claimed invention, all the limitations of a claim must be taught or suggested by the prior art. *In re Royka,* 490 F.2d 981, 180, USPQ 580 (CCPA 1974). JP '283 and ASM Handbook do not teach or suggest induction heating the cold drawn low-carbon steel tube to form a low-carbon steel tube that yields plastically more than about 5% before fracturing at temperatures down to about -100°C when stress sufficient to cause the low-carbon steel tube to so yield is applied to the low-carbon steel tube. The Office Action's statement that the advantages of induction heating are known and that one would modify the heat treating step of JP '283 based on these advantages is not a motivation to modify the teachings of JP '283. The Office Action by this statement merely suggests it is obvious to try induction heating instead of other forms of heating. Obviousness to try one process versus another is not the standard of obviousness and cannot be used to establish obviousness under 35 U.S.C. §103. Gillete Co. v. S.C. Johnson & Sons, Inc., 919 F.2s 720, 16 USPQ2d 19223, (Fed. Cir. 1990).

Additionally, regardless of whether it is obvious to induction heat the low-carbon steel tube of JP '283, JP '283 and ASM Handbook still do not teach or suggest that such an

induction heated tube yields plastically more than about 5% before fracturing at temperatures down to about -100°C when stress sufficient to cause the low-carbon steel tube to so yield is applied to the low-carbon steel tube.

Further, as discussed above with respect to claim 1, it is unexpected that an induction heated low-carbon steel tube having a composition as recited in claim 5 would exhibit substantially improved ductility properties at temperatures down to -100°C compared to a low-carbon steel tube having a similar composition but heat treated by conventional heat treatment process. Therefore, withdrawal of the rejection of claim 7 is respectfully requested because JP '283 and ASM Handbook fail to teach or suggest all of the limitation of claim 7 and the method recited in claim 7 exhibits unexpected results.

35 U.S.C. §103 rejection in view of JP '635

Claims 1 and 3 were rejected under 35 U.S.C. §103(a) as being unpatentable over the English abstract of JP '635.

Claim 1 is patentable over JP '635 because: (1) JP '635 does not teach or suggest an induction heated low-carbon steel tube, (2) JP '635 does not teach or suggest a low-carbon steel tube that yields plastically more than about 5% before fracturing at temperatures down to about -100°C when stress sufficient to cause the low-carbon steel tube to so yield is applied to the low-carbon steel tube, and (3) the induction heated low-carbon steel tube of claim 1 exhibits unexpected result.

The Office Action states that the English abstract of JP '635 discloses a seamless steel tube having a composition with constituents whose wt% ranges overlap those recited by claim 1 and that such overlap establishes a prima facie case of obviousness because it would be obvious to one of ordinary skill in the art to select the claimed alloy weight percent ranges from the broader disclosure of the prior art since the prior art teaches the same utility and similar properties of high-strength and low-temperature toughness.

JP '635, however, does not teach or suggest that the steel tube is induction heated during its manufacturing process. JP '635 teaches various heat treating processes but there is nothing in the JP '635 that teaches or suggests that any of these process involve induction heating.

Additionally, JP '635 does not disclose or suggest a low-carbon steel tube that yields plastically more than about 5% before fracturing at temperatures down to about -100°C. As discussed above, it is well known that the mechanical properties of a low-carbon steel tube

(and for that matter any article formed from steel) are a function of not just the composition of the low-carbon steel, but also of the processes used to form the low-carbon steel into the low-carbon steel tube. Thus, although the composition of the low-carbon steel used to form the low-carbon steel tube of the present application could potentially be prima facie obvious over a similar low-carbon steel composition, the mechanical properties of a low carbon-steel tube formed from the low-carbon steel would not.

There is nothing JP '635 that teaches or suggests that the steel tubes of JP '635 are processed or mechanically treated in any way that would provide a low-carbon steel tube that yields plastically at least about 5% at temperatures down to about -100°C. Thus, JP '635 fails to teach all of the limitations of claim 1.

Further, as discussed above with respect to claim 1, it is unexpected that an induction heated low-carbon steel tube having a composition as recited in claim 1 would exhibit substantially improved ductility properties at temperatures down to -100°C compared to a low-carbon steel tube having a similar composition but heat treated by conventional heat treatment process. Therefore, withdrawal of the rejection of claim 1 is respectfully requested because JP '635 fails to teach or suggest all of the limitation of claim 1 and the low-carbon steel tube of claim 1 exhibits unexpected results.

Claim 3 depends directly from claim 1 and therefore should be allowable because of the aforementioned deficiencies discussed above with respect to the rejection of claim 1. Additionally, claim 3 is patentable over JP '635 because JP '635 does not teach or suggest a low-carbon steel tube that has a has a tensile strength of at least about 130,000 psi, a yield strength of at least about 104,000 psi, and an elongation at break of at least about 14%.

JP '635 does not teach or suggest the tensile strength and the elongation at break of the low-carbon steel tubes recited in JP '635. The yield strength of various low-carbon steel tubes of JP '635, however, are disclosed in Tables 2. The only low-carbon steel tubes that meet the yield strength recited in claim 3 (i.e., at least about 104,000 psi (73 kgf/mm^2)) are Examples 11-14, 16, and 22-23. The low-carbon steel tubes of Example 11-14, 16, and 22-23, however, all have compositions or chemistries that are outside the ranges recited in claim 1. Specifically, Examples 11-14, 16, and 22-23, as shown in Table 1, all have carbon, chromium, molybdenum, and manganese contents that are outside of the claimed ranges. Thus, the only steel tubes taught in JP '635 that meet the recited yield strength have chemistries outside the claimed range, and one would not expect that the low-carbon steel

tubes recited in JP '635 have the same properties as the low-carbon steel tubes recited in claim 3. Therefore, withdrawal of the rejection of claim 3 in view of JP '635 is respectfully requested because JP '635 does not teach the specific composition of the low-carbon steel tube recited in claim 1 and does not teach the mechanical process recited in the claim (i.e., induction heating) used to form a low-carbon steel tube having the properties recited in claim 3.

<u>Non-statutory double patenting rejection.</u>

Claims 1 and 3 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting.

A terminal disclaimer is attached to the application to overcome this rejection. Accordingly, withdrawal of this rejection is respectfully requested.

In view of the foregoing, it is respectfully submitted that the above-identified application is in condition for allowance, and allowance of the above-identified application is respectfully requested.

Please charge any deficiencies or credit any overpayment in the fees for this amendment to our Deposit Account No. 20-0090.

Respectfully submitted,

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